



**POTENTIAL ECONOMIC IMPACT OF COMMERCIAL OFFSHORE
AQUACULTURE IN THE GULF OF MEXICO**

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ABSTRACT

The Gulf of Mexico commercial offshore aquaculture industry would include the production, processing and distribution of aquaculture species. The use of cages to grow food fish in the Gulf waters had been a subject to recent research efforts and commercial ventures. Three-inch red drum fingerlings were raised to market-size fish in less than 12 months in a research project off Freeport, Texas. The Gulf of Mexico Offshore Aquaculture Consortium attempted to grow cobia from in an experimental cage 40 km off Pascagoula, Mississippi. The overall goal of this paper was to estimate the potential economic impact of the establishment of economically viable commercial offshore aquaculture production systems in the Gulf. The potential impact of the industry was estimated by using IMPLAN and the 2000 Gulf states data which facilitated the use of the most appropriate multipliers. Commercial offshore aquaculture production was represented by the "Miscellaneous livestock" sector. Commercial seafood processing was represented by the "Prepared Fresh or Frozen Fish or Seafood" sectors. The ex-vessel values of the Gulf commercial fishing and processing sectors were retrieved from the National Marine Fisheries Service database. The direct effects created by the establishment and operation of a single production system with 12 cages would generate indirect and induced effects. Indirect effects consist of the inter-industry effects of the input-output analysis. Induced effects consist of the impact of household expenditures in input-output analysis. The sum of the direct, indirect, and induced effects is equal to the total economic impact measured in terms of output (\$), jobs, labor income (\$), and tax collections (\$).

KEYWORDS: offshore aquaculture; Gulf of Mexico; economic impact

INTRODUCTION

Economic benefits from aquaculture production accrue not only to those directly involved in the industry but contribute to increased employment and revenue of the entire region through multiplier effects. Aquaculture can also supplement domestic fisheries, increase seafood production and provide stability for the seafood industry. A successful approach to solving many current domestic fishery problems is through the development of an intensive aquaculture program in the United States. While farmed seafood contributes more than 25% by weight to world seafood production, U.S. production is less than 3% of world aquaculture production. Coastal and offshore aquaculture frequently involves new species, product forms and production technologies. During the last decade, several species have been raised along the Gulf of Mexico including catfish, baitfish, gamefish, crawfish, red drum, hybrid striped bass, tilapia, alligator, freshwater prawn, oyster and carp.

The Gulf of Mexico commercial offshore aquaculture (COAC) industry would include the production, processing and distribution sectors of aquaculture species in these waters. The use of cages to grow food fish in the Gulf of Mexico waters had been a subject to recent research efforts and commercial ventures (GMFMC, 2004). SeaFish Mariculture, LLC (SFM) successfully raised red drum from 3-in fingerlings to market-size fish in less than 12 months in a fishfarming research project off Freeport, Texas (GMFMC, 2004). The Gulf of Mexico Offshore Aquaculture Consortium (OAC) attempted to grow cobia from fingerlings to market-size in an experimental cage 40 km off Pascagoula, Mississippi (Bridger, et al., 2003).

The overall goal of this paper is to estimate the potential economic impact of the establishment of economically viable commercial offshore aquaculture production systems in the

Gulf of Mexico. Specifically, it aims to estimate the over-all economic impact of the initial establishment and operation of COAPS in the Gulf of Mexico; and determine the economic sectors with the strongest linkage to these new offshore aquaculture production systems.

MATERIALS AND METHODS

The potential economic impact of the COAC industry was estimated by using IMPLAN Professional 2.0 Software and the 2000 Gulf of Mexico States IMPLAN data files, including Florida, Alabama, Mississippi, Louisiana and Texas. These impact planning software and data files facilitated the estimation of economic impacts with the use of the most appropriate multipliers (MIG, 1999). Two series of economic impact estimates were prepared for the COAC industry. The first series of estimates included those associated with the initial investment expenditures that would be incurred during the establishment or construction year. The second series of estimates covered those annual expenditures that would be incurred in operating the commercial offshore aquaculture production system (COAPS). Offshore aquaculture production would also enhance both commercial and recreational fishing in the nearby waters. Additional production of the candidate species would also increase both processing and distribution activities in both existing and new processing and distribution plants.

The production sector of the COAC industry would be consisted of the culture of saltwater aquaculture species in offshore waters of the Gulf. Posadas and Bridger (2003) developed a hypothetical COAPS based on current information on offshore grow-out technology in the Gulf. The candidate species include cobia (*Rachycentron canadum*), red snapper (*Lutjanus campechanus*), and red drum (*Sciaenops ocellatus*). The production system consists of an

aquaculture service vehicle (ASV) and Ocean Spar Sea Station cages. The ASV is a mobile offshore support facility which can be used to adjust the deployment of the sea cages. The 3000- m^3 cages are deployed in offshore waters, at least 24 m deep, and assumed to hold 20-30 kg/m^3 of market-size fish. An economically viable hypothetical COAPS consisted of 12 cages which would require an initial fixed investment of \$3.85 M.

The COAPS sector was represented by the “Miscellaneous livestock ” IMPLAN sector 9 which corresponded to the 1987 Bureau of Economic Analysis (BEA) Standard Industrial Classification (SIC) codes 0271 and 0272 (MIG, Inc., 1999). The commercial seafood processing sector involved plants engaged in primary wholesale and processing activities. IMPLAN sector “Prepared Fresh or Frozen Fish or Seafood, 98” corresponded to the 1987 BEA-SIC code 2092 (MIG, Inc., 1999). Commercial harvesting is represented by IMPLAN sector 25 which corresponded to the 1987 Bureau of Economic Analysis (BEA) Standard Industrial Classification (SIC) code 0910 (MIG, Inc., 1999). The ex-vessel values of the Gulf commercial fishing sector were retrieved from the NMFS (2004) website.

Extrapolating a potential COAC industry from these hypothetical COAP models presents is a big leap forward to the realm of uncertainty. Several key economic and marketing issues need to be addressed when projecting an industry-wide economic impact of COAC with more than one COAPS consisting of 12-cages. There are no published inventory of offshore areas suitable for COAPS which do not have conflicts with current and future users of these marine resources. Appropriate technology for offshore growout - stocking, feeding, and harvesting - still need to be developed and tested under extreme remote conditions prevailing in the Gulf growing waters. There is not enough information that can be used to measure the reaction of the

domestic market to expansion in the supply of the cultured species arising from the establishment of COAPS and imports from foreign producers. The logistics of supplying COAPS with manpower and material to sustain day-to-day operations still remain to be developed and tested under Gulf conditions. Public perceptions, legal and political mind-sets, and environmental constraints associated with COAPS have to be addressed in order to make the investment climate more favorable. Current regulations affecting the harvesting, production and marketing of the candidate species in both state and federal waters are major constraints every grower, lender or investor has to deal with before deciding to enter into this highly uncertain venture.

RESULTS AND DISCUSSION

Impact of Initial Investment in a Single COAPS

The initial investment expenditures in setting-up a single COAPS with 12 cages that would be incurred during its establishment year would generate additional output of economic goods and services valued at \$6.84 million (Table 1). Associated with this added economic activity would be an increase in the derived demand for 197 workers. The expected increase in labor income, which consists of employee compensation and proprietor's income, would reach \$2.17 million. Indirect business tax collections are estimated at \$210,870. Federal income tax collections would include \$231,000 from personal income taxation, and \$59,000 from corporate income taxation.

Annual Impact of Operating a Single COAPS

Single COAPs with 12 cages stocked with the candidate species would require different

levels of input - primarily fingerlings and feed (Table 2). Annual fish production would be 1.08 M mt for all three species. Differences in ex-vessel prices would generate varying levels of annual fish sales, cobia - \$5.67 M, red snapper - \$5.94 M, and red drum - \$5.13 M..

With the annual fish sales expected from the economically feasible single COAPS with 12 cages, the economic impact to the Gulf regional economy were measured by using four indicators: output of goods and services, jobs, labor income, and indirect business taxes. Using the same 2000 Gulf IMPLAN model, additional output produced would range from \$9.1 M to \$10.2 M. The number of jobs created would be between 262-289 positions. The single COAPS would generate additional proprietors income and employee compensation ranging from \$2.9 M to \$3.2 M. Annual indirect business taxes associated with the added output produced by a single COAPS would amount to at least \$281,000. This tax collection does not include personal income taxation that could be collected from employment and ownership of these COAPS. Federal and state personal income tax collections from households would amount to \$340,000 and \$11,000, respectively. Tax collections from corporate profits would reach \$87,000 and \$4,000 for federal and state taxing authorities, respectively.

Impact of Current Commercial Fish Harvesting

Commercial harvesting of the candidate species is limited by state and federal regulations. Recent domestic commercial landings valued at ex-vessel prices exceeded \$10 million (Figure 3). Using the same 2000 Gulf IMPLAN model, the commercial landings valued at \$12.4 million, if all landed in the Gulf, could have created an economic impact in the region amounting to \$20.1 million output of goods and services (Table 4). A total of 628 jobs could

have been created and a combined income of workers and proprietors could reach \$10.3 million. Business establishments would also remit indirect business taxes amounting to \$0.86 million.

Impact of Current Commercial Foodfish Processing

The 64 Gulf processing plants engaged in the primary processing and wholesaling of foodfish handled a total plant-gate value of foodfish products amounting to \$52.7 million in 2000 (NMFS, 2004). By using the same 2000 Gulf IMPLAN model, total economic impact of commercial foodfish processing reached \$80.8 million (Table 5). This sector also provided 769 jobs and generated \$17.6 million labor income to the region. Indirect business taxes collected from this sector amounted to \$1.3 million.

Sectoral Economic Linkages

The direct effects created by the establishment and operation of a single COAPS with 12 cages would generate indirect and induced effects. Indirect effects consist of the inter-industry effects of the input-output analysis. Induced effects consist of the impact of household expenditures in input-output analysis. (MIG, Inc., 1999). The sum of the direct, indirect, and induced effects is equal to the total economic impact measured in terms of output (\$), jobs, labor income (\$), and tax collections (\$).

The indirect or inter-industry linkages would mostly occur among the agriculture (27%), manufacturing (23%), trade (14%), and transportation, communication, and public utilities (TCPU = 14%) sectors (Figure 1). Additional indirect linkages could be expected from the services (8%), and finance, insurance, and real estate (FIRE = 7%) sectors.

The induced effects associated with increased household expenditures would be mostly observed among the services (30%), trade (24%), FIRE (23%) sectors (Figure 2). The manufacturing and TCPU sectors would share some of the induced effects (9%) generated by added household spending.

CONCLUSIONS

The economic impact of an emerging offshore aquaculture industry and existing fish harvesting and processing industry on the regional economy was estimated by using IMPLAN. The annual economic impact to the Gulf of Mexico region of a single offshore aquaculture production system consisting of 12 cages would consist of additional economic output ranging from \$9.1M to \$10.2 M. In comparison, current commercial harvesting of the three candidate species in the Gulf of Mexico, which are limited by state and federal regulations, created an economic impact in the region amounting to \$20.1 M. The subsequent primary processing and wholesaling of all foodfish species in the Gulf of Mexico created a total economic impact reaching \$80.8 M.

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TABLE 1. Summary of economic impact of initial investment expenditures on a single COAPS using 12 cages incurred during the establishment year

Item	Output (\$ x 10 ⁶)	Employment (jobs)	Labor Income (\$ x 10 ⁶)	Indirect Business Taxes (\$ x 10 ³)
Direct	3.85	156	1.17	46.33
Indirect	1.59	24	0.49	74.67
Induced	1.40	17	0.51	89.86
Total	6.84	197	2.17	210.87

TABLE 2. Inputs and outputs in an economically viable COAPS using 12 cages stocked with candidate species under enhanced market and improved growth conditions. (Posadas and Bridger, 2003).

Item	Unit	COBIA	SNAPPER	DRUM
Stocking density	fish/m ³	5.70	66.74	33.06
Stocking size	g/fish	10.00	10.00	10.00
Improved growth rate	g/mo	729.00	46.00	100.00
Annual fingerling requirements	1,000 pc	205.20	2,402.64	1,190.16
Average fingerling cost	\$/1000 pc	750.00	750.00	750.00
Annual fingerling costs	\$ x 10 ⁶	0.15	1.80	0.89
Average feed cost, bulk-rate	\$/mt	705.48	705.48	705.48
Annual feed requirements	1,000 mt	1.62	1.62	1.62
Annual feed costs, bulk-rate	\$ x 10 ⁶	1.14	1.14	1.14
Annual fish production, heads-on	1,000 mt	1.08	1.08	1.08
Enhanced ex-vessel price, heads-on	\$/kg	5.25	5.50	4.75
Improved harvest size, heads-on	kg/fish	6.57	0.56	1.21
Enhanced annual fish sales, gross	\$ x 10 ⁶	5.67	5.94	5.13

TABLE 3. Summary of annual economic impact of a single COAPS using 12 cages stocked with candidate species under enhanced market and improved growth conditions

Item	Output			Employment			Labor Income			Indirect Business Taxes		
	(\$ x 10 ⁶)			(jobs)			(\$ x 10 ⁶)			(\$ x 10 ³)		
	COBIA	SNAPPER	DRUM	COBIA	SNAPPER	DRUM	COBIA	SNAPPER	DRUM	COBIA	SNAPPER	DRUM
Direct	5.7	5.7	5.1	229	232	208	1.7	1.7	1.6	68.1	69.0	61.7
Indirect	2.3	2.4	2.1	35	36	32	0.7	0.7	0.6	109.8	111.2	99.5
Induced	2.1	2.1	1.9	25	25	22	0.7	0.8	0.7	132.2	133.8	119.7
Total	10.1	10.2	9.1	289	293	262	3.2	3.2	2.9	310.2	314.0	281.0

TABLE 4. Summary of annual economic impact of combined commercial fish harvesting of cobia, red snapper, and red drum in the Gulf of Mexico, 2000

Item	Output (\$ x 10 ⁶)	Employment (jobs)	Labor Income (\$ x 10 ⁶)	Indirect Business Taxes (\$ x 10 ³)
Direct	12.4	586	7.6	389.9
Indirect	0.9	8	0.3	33.6
Induced	6.7	34	2.5	433.2
Total	20.1	628	10.3	856.7

TABLE 5. Summary of annual economic impact of commercial foodfish processing in the Gulf of Mexico, 2000

Item	Output (\$ x 10 ⁶)	Employment (jobs)	Labor Income (\$ x 10 ⁶)	Indirect Business Taxes (\$ x 10 ³)
Direct	52.7	338	7.3	318.1
Indirect	17.0	297	6.3	1,009.4
Induced	11.1	133	4.0	0.7
Total	80.8	769	17.6	1,328.1

Figure 1. Percent distribution of indirect annual economic impact of a single COAPS using 12 cages stocked with candidate species under enhanced market and improved growth conditions.

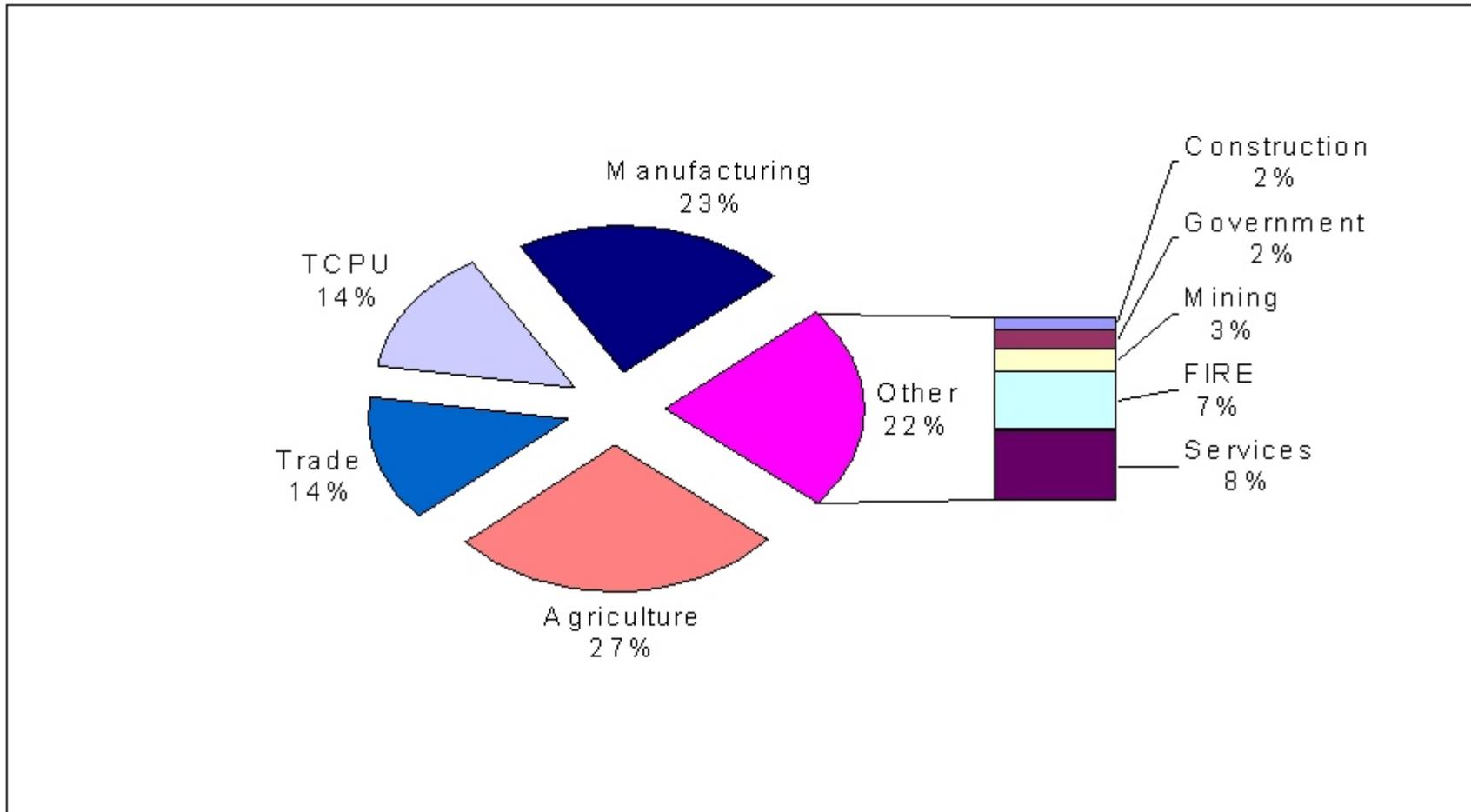


Figure 2. Percent distribution of induced annual economic impact of a single COAPS using 12 cages stocked with candidate species under enhanced market and improved growth conditions.

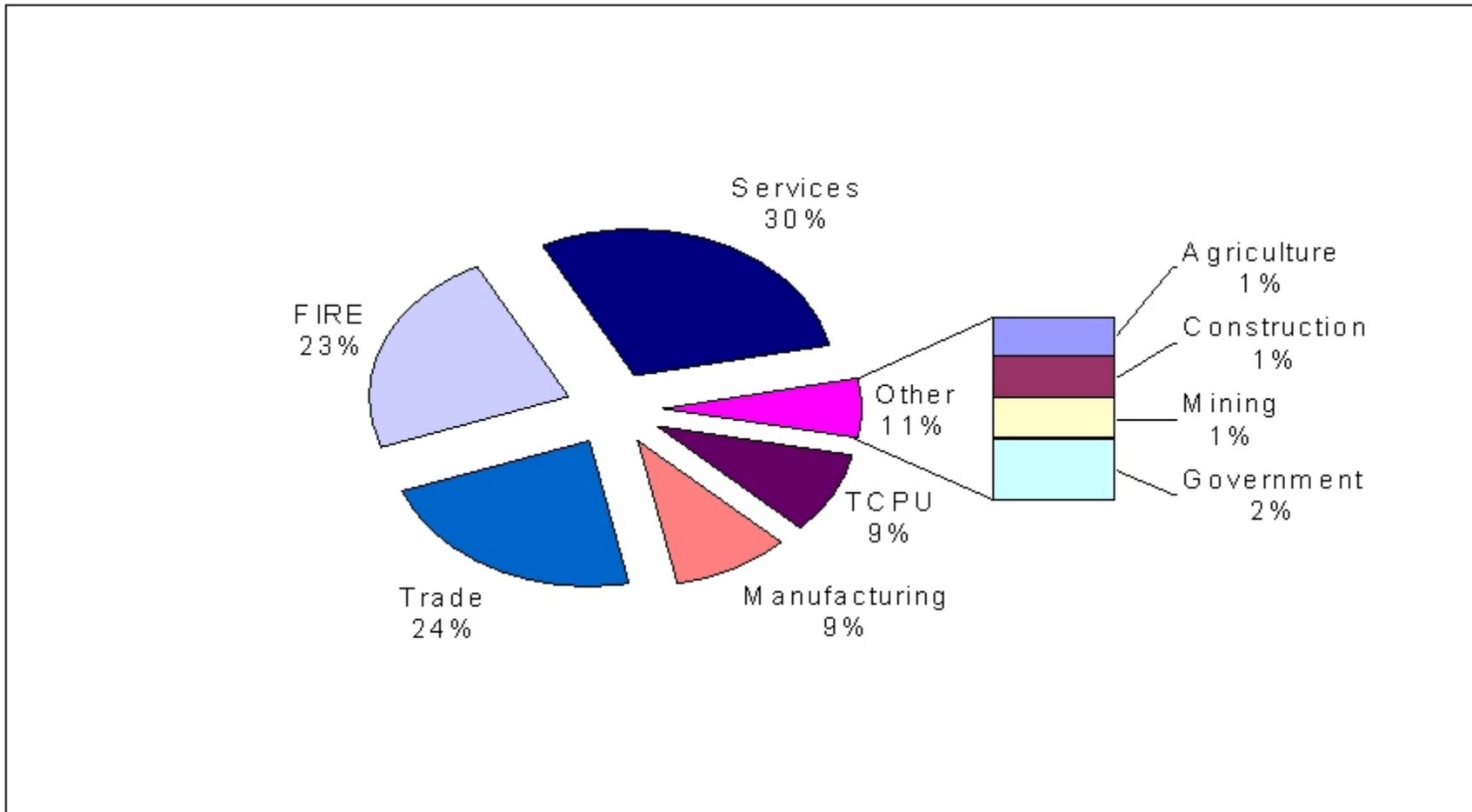


Figure 3. Ex-vessel values of the combined commercial landings of the candidate species in the United States, 1950-2002. Source: NMFS (2004)

